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July 21, 1993

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

HAND DELIVERY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
Room 222
1919 M Street, N.W.
Washington, D.C. 20554

Re: GEN Docket No. 90-314 ✓
ET Docket No. 92-100 ✓
Ex Parte Presentation

PCS ACTION, INC.

1200 19TH STREET, NW • 7TH FLOOR • WASHINGTON, DC 20036 • (202) 861-2957 • FAX: (202) 861-3963

WHITE PAPER ON PCS SPECTRUM ISSUES

July 21, 1993

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Of all the issues facing the Commission as it authorizes personal communications services ("PCS"), the most crucial is the size of the spectrum allocation to be authorized for PCS licensees. The amount of spectrum PCS licensees will be permitted to utilize will determine the number of Americans who can be served by PCS, the speed with which PCS will be deployed, the voice quality PCS will be able to attain, whether highly demanded PCS data transmission will be feasible, and whether PCS will be a viable competitor to cellular telephony and, ultimately, the local exchange -- in short, whether PCS will succeed or fail.

The members of PCS Action -- telecommunications equipment manufacturers, entrepreneurs, multi-media companies, an interexchange carrier and a cellular service provider -- believe strongly that an allocation of 40 MHz per PCS licensee is necessary. Those who advocate lesser allocations are merely attempting to prevent PCS from reaching its full potential in the marketplace, or fundamentally misunderstand the nature of PCS and the constraints facing its implementation in a shared spectrum environment. An allocation of 40 MHz per licensee is not excessive or extravagant; it is simply the allocation that the science underlying PCS demands. The major manufacturers that will design and build PCS equipment -- including Motorola, Northern Telecom, Omnipoint and Qualcomm -- agree that a 40 MHz assignment per licensee is imperative to permit PCS to be implemented in the United States, particularly given the Commission's Emerging Technology decisions grandfathering incumbent microwave systems. This allocation is consistent with the vision American consumers hold for PCS, as well as with PCS assignments by our international competitors, which are moving ahead to implement PCS this year with allocations that are effectively larger than any option being considered by the Commission.

I.
The American Vision for PCS

The decisions surrounding the implementation of PCS need not be made in a vacuum. The PCS industry has undertaken some 200 PCS technical and marketing experiments and has conducted a significant amount of research into the characteristics American consumers will demand of PCS. Each study establishes conclusively that American consumers will embrace a PCS that is fully featured and would reject any vision of PCS that delivers less.^{1/} American consumers demand high-quality voice and data services, high capacity, high-speed handoff, and wide-area coverage -- PCS with a capital "P". Systems offering only small service areas because of limited spectrum would be rejected out-of-hand by the American consumer.

Studies emphasize the importance for PCS of broad coverage, high voice quality, full functionality, and data applications.^{2/} Affordability and accessibility boosts usage of PCS services,^{3/} and the successful introduction of PCS will mean an acceleration in the penetration of all wireless services.^{4/}

International experience with the actual implementation of PCS corroborates the results of American PCS experimenters. In the United Kingdom, for example, four CT-2 licenses were issued in 1989 and only one CT-2 licensee now survives. CT-2 licensees could provide only services with limited coverage, mobility, and functionality. Licensees were unable to provide the full-fledged wireless services British consumers, like American consumers, demand.

These findings have led telecommunications companies developing PCS services to plan the deployment of affordable services that will enable individuals to communicate

1/ See PCS Trial Results: A Telocator Survey 1 (1993) ("users chafe at coverage restrictions and broad coverage is the top priority for trial participants . . . users want cellular-like service -- including two-way calling and the ability to hand off -- priced lower than cellular").

2/ See, e.g., id. at 1 & 4; Deloitte & Touche, User Perspectives on the Future of Wireless Communications (1992).

3/ See, e.g., American Personal Communications, Seventh Progress Report, FCC File No. 2056-EX-ML-91 (April 28, 1992).

4/ See, e.g., Deloitte & Touche, supra, at 6.

The presence of incumbents that either will remain permanently in the 2 GHz band or that cannot be relocated for a period of years raises two key issues. First, how much spectrum is required to permit PCS licensees to inaugurate PCS, during the "transition period" and beyond? Second, what would a regime under which insufficient spectrum allocations force massive relocations imply for the consumer cost and timing of a nationwide roll-out for PCS?

A.

The Need to Share Spectrum. Every spectrum-availability study that has been performed has found conclusively that PCS spectrum allocations of 20 MHz, or even 30 MHz, would be insufficient for implementation of PCS in major markets. The need for a sufficient amount of spectrum to permit PCS to be implemented in a shared environment is simply a scientific fact of life PCS licensees and the Commission must face.

Early studies found, quite correctly, that there is a substantial amount of unused spectrum in the 140 MHz of the 1.85-1.99 GHz band that is available for PCS.^{6/} When the spectrum available in this total of 140 MHz is divided into discrete spectrum blocks, however, and microwave protection

American public. For any sharing technology effectively to "work around" incumbent users, however, there must be at least some spectrum available. Just as one cannot drive a car around an obstacle if the obstacle blocks the entire road, it is physically impossible for a PCS licensee to share with microwave if all its spectrum is blocked by microwave incumbents.

Under a 20 MHz allocation, for example, one microwave licensee could block PCS from being implemented in a large portion of the geographic area covered by a PCS license.^{7/} Microwave licensees typically utilize two 10 MHz channels -- a total of 20 MHz -- that will correspond to PCS allocations. (When the use of IF filters on microwave receivers is taken into account, moreover, some microwave users can require interference protection for bandwidths of between 17 and 28 MHz per channel.) Microwave protection criteria, in their current versions, require consideration of systems within 250 miles in every direction. One microwave incumbent, then, can stymie the implementation of PCS for the entire service area of a PCS licensee if spectrum blocks are only 20 or 30 MHz wide. Because there are 10,000 microwave licensees, at least one-quarter of which will be permanently grandfathered, and because these licensees are spread throughout the United States, a 20 MHz allocation for PCS equates to zero spectrum available for PCS in significant portions of the country. The PCS industry would never develop under these constraints, and federal auction revenues for PCS licenses would be minimal.

Studies examining PCS implementation in specific markets confirm this result. In one study, American Personal Communications analyzed each microwave path in each of the largest 11 United States cities for each of the Commission's spectrum allocation proposals -- 40 MHz per licensee, 30 MHz per licensee, and 20 MHz per licensee. The study found that allocations of 20 MHz and even 30 MHz would yield too little

^{7/} See Comsearch, Analysis of the 20 MHz, 30 MHz, & 40 MHz PCS Block Allocations, filed with MCI Telecommunications Corp., Comments (Gen. Docket 90-314, Nov. 9, 1992). Comsearch is an independent frequency coordination firm. Comsearch found that a 20 MHz allocation would permit a single microwave effectively to block PCS. Even under a 30 MHz allocation, spectrum within a PCS allocation will be blocked more than 20 percent of the time.

usable spectrum to permit PCS to be deployed.^{8/} In Chicago, for example, an allocation of 20 MHz results in, depending upon the PCS licensee, between 33 percent and 57 percent of the area not having spectrum available for PCS.

In another study, Cox Enterprises analyzed each microwave path in San Diego, California, and concluded that 20 or 30 MHz allocations would render PCS an impossibility -- 10 of the 24 incumbents in San Diego are public safety licensees, and even a 30 MHz allocation would be insufficient.^{9/} Other markets show similar results.

Even if microwave paths can be relocated by private negotiation in the near term, the problem of spectrum congestion will not magically disappear. Even assuming that each PCS licensee can relocate the three worst-case microwave links from that PCS licensee's spectrum block in each major market -- which will not be possible in all cases^{10/} -- the amount of spectrum available for PCS use would increase, on average, only slightly. In Los Angeles, for example, a 30 MHz allocation would yield only an average of 16.9 MHz of useable spectrum even after the three worst-case microwave stations in each PCS licensee's spectrum block had been relocated and a 20 MHz allocation would yield only 12.1 MHz of useable spectrum, on average, under the same circumstances. Included in these averages, moreover, is a significant amount of area in which there would be no spectrum at all available even after all three worst-case microwave users are relocated -- under a 30 MHz allocation, up to 22.9 percent of the geographic area in Los Angeles has no spectrum available for PCS; under a 20 MHz allocation, up to 32.8 percent of the area of Los Angeles has no spectrum available. In Chicago, only 14.2 MHz of useable spectrum, on average, would be available under a 20 MHz

^{8/} See American Personal Communications, Report on Spectrum Availability for Personal Communications Services Sharing the 1850-1990 MHz Band with the Private Operational Microwave Service (Gen. Docket 90-314 & ET Docket 92-9, November 1992). Data for this study was obtained from Comsearch and FCC files.

^{9/} See Cox Enterprises, Inc., Reply Comments, pp. 10-11 & Comsearch Appendix (Gen. Docket 90-314, Jan. 8, 1993).

^{10/} If any of these licensees is a public safety entity, or would be entitled to remain in the 2 GHz band for technical reasons, or would simply refuse to move during the "transition period," the PCS licensee would be powerless to relocate them and any potential spectrum gains from a theoretical relocation would not be realized.

allocation after relocation of the worst three microwave stations by each licensee and up to 36 percent of the Chicago area would have no spectrum available. In Houston, only 13.5 MHz of useable spectrum would be available, on average, with a 20 MHz allocation after relocating the three worst-case incumbents in each PCS licensee's spectrum block and up to 35.2 percent of the Houston area still would have no spectrum available for PCS.^{11/} These results are, again, only averages; in each case, significant geographic portions of the market are blocked entirely by microwave users.^{12/}

Studies have focused on major markets for good reason. If PCS cannot be brought to the major population centers of the United States, it will never emerge as an effective telecommunications service. Moreover, some 50 percent of Americans live in or near the top ten major trading areas, where microwave congestion is and will be a significant problem. However, microwave usage is not solely a large city phenomenon. Microwave users operate throughout the United States, in mid-size cities, small towns, and rural areas. Cities such as Orlando, Florida (36 paths, 32 public safety) and even Tulsa, Oklahoma (24 paths, 11 public safety) and Bismarck, North Dakota (15 paths) have significant microwave usage.^{13/} Microwave congestion under allocations as small as 20 MHz will be a fact of life even in sparsely populated areas, because a single microwave user can block all spectrum in a PCS licensee's assigned frequencies. Microwave congestion in the 2

^{11/} See Engineering Supplement of J. Barclay Jones, Attachment A to Letter from Wayne N. Schelle to Chairman Alfred C. Sikes (Gen. Docket 90-314, Jan. 8, 1992).

^{12/} For this reason, it is meaningless to point out that the Hong Kong digital cellular system has been allocated only 5 MHz of clear spectrum. This allocation would be uniformly clear throughout the entire geographic area to be served; under an allocation that yields an effective average of 5 MHz, after sharing, entire geographic areas would be blocked out entirely by microwave use. Moreover, PCS is not digital cellular. Because of the size of this allocation (which may have to be supplemented to meet capacity demands when commercial service is inaugurated), the Hong Kong system will be limited to compressed voice service. PCS in the United States will be much more than simply a voice service (as will, for that matter, cellular).

^{13/} See Comsearch, Microwave Path Usage On 1850-1990 Band (Gen. Docket 90-314, April 1993).

GHz band is a nationwide problem demanding a nationwide solution.

The fact that some PCS applications will permit some use of microcells -- generally defined as base stations with radii of 1000 feet -- does not obviate the need for a sufficient spectrum allocation. To begin with, any vision of a PCS based entirely on microcells is not in the business plan of any PCS Action member (or any PCS proponent of which we know). Base station radii of up to three miles will be necessary for cost-effective deployment of PCS, even in metropolitan areas but especially in less densely populated areas; a vision of PCS based entirely on 1000-foot microcells no longer exists.^{14/}

B.

Delays Implicit in Relocation. PCS will enter a highly competitive marketplace in which entrenched cellular entities have achieved wide-area, regional coverage. To be competitive with cellular and wide-area ESMR services, PCS will be forced to build out entire systems for an initial launch. The vast majority of the base stations in a PCS system must be active when the service is offered to the public or PCS will fail to gain a competitive foothold. PCS, then, cannot afford the luxury of rolling out its service gradually as cellular did in the competition-free environment of the mid-1980s. Systems elsewhere in the world recognize the imperative of building virtually complete systems by the first day of commercial launch; in the United Kingdom, Mercury Personal Communications built 250 cell sites before turning on the first user, and in Germany, the PCS licensee will have to build thousands of cell sites before launching its wide-area service. PCS licensees must have a sufficient amount of spectrum to permit wide-area service to be initiated on the first day of commercial launch.

Beyond doubt, delay in the full inauguration of PCS must be avoided. Insufficient spectrum allocations, however, would

^{14/} And, of course, comparing digital PCS to analog cellular is misleading -- cellular carriers are converting to digital technologies with the same efficiency as PCS digital technologies and are implementing these technologies in 25 MHz of clear spectrum. The need to accommodate current analog users of spectrum may require part of a cellular carrier's spectrum to be reserved. However, the magnitude of that reservation will not approach the level of spectrum preemption that incumbent microwave users will cause to PCS licensees, and alleviation of the cellular reservation is entirely within the control of the cellular licensee.

stall PCS implementation and development in markets across the country because PCS licensees would not have access to the spectrum needed to implement PCS. PCS licensees would be forced to abandon the sharing technologies that the Commission has found so valuable and revert to a mandated band-clearing strategy. Forcing a clearing of the band would provoke delays of two types.

First, too-small allocations would prevent PCS licensees from having sufficient spectrum even to begin PCS implementation in the near term. Comsearch, an independent frequency coordination firm, has found that a 20 MHz PCS allocation would require 100 percent of public safety licensees and 50 percent of all licensees to be relocated during the first three years after PCS licensing.^{15/} PCS licensees thus would be forced for their very survival to begin negotiations with incumbent microwave users during the "transition period."

During this "transition period," microwave users would be under no obligation to relocate or to limit their demand for payment to their costs of relocating. PCS licensees, fresh from paying auction prices to attain PCS spectrum, would be forced to negotiate in an open market -- essentially, a second, private auction -- to gain access to the very spectrum they had been licensed. Microwave licensees, moreover, will have every incentive to attempt to reap the perceived market value of the spectrum they have been licensed. These negotiations would be inordinately time-consuming and expensive, delaying service to the consumer and driving up the cost of the service that ultimately will be provided. Under this scenario, PCS stands to lose the very characteristic that has driven the optimism of the PCS industry -- the ability to offer a low-cost, mass market service that will meet, for the first time, the tetherless telecommunications needs of the majority of the American public.

Second, even if negotiations can be completed successfully, the logistics of relocating microwave licensees would cause significant time delays. Too-small spectrum allocations would require all PCS licensees to be working to relocate microwave users at essentially the same time. Equipment for relocation bands, which are just now being rechannelized by the Commission, would have to be produced in mass quantities in time for this relocation; innumerable engineers would have to be deployed to effectuate the relocation. Although some have intimated that relocation of

^{15/} See Comsearch, Spectrum Allocations and Their Impact on Microwave User Relocations: A Case Study (April 12, 1993).

microwave users requires little more than switching microwave radios, this is not the case. Many systems are complex with multiple paths, and will require substantial time to perform the frequency coordination, engineering, licensing and installation. Today this process often takes 18 months for a single link. If relocations such as these will be necessary in every major market in virtually the same time frame, the industry will be unable to respond and the inauguration of PCS will be inevitably delayed.

The public interest demands that PCS be implemented as quickly as possible. Until PCS is implemented, cellular will not be subjected to full and direct price and service competition; American consumers will be harmed by delay.^{16/} As all the studies that have been performed show conclusively, PCS is a highly demanded service.^{17/} PCS will create 300,000 high quality new jobs for Americans.^{18/} It will permit our

requiring quick regulatory action to begin the licensing of PCS. Insufficient spectrum allocations would frustrate the very goals Congress expected to achieve by mandating quick regulatory action.

III.

Other Reasons for 40 MHz Assignments

As pivotal as the microwave congestion issue is to the debate over spectrum allocations, it is not, by any means, the sole reason for an allocation of 40 MHz per PCS licensee.

between 36 and 49 MHz of clear spectrum each to service the public's demand for PCS.^{22/}

The Need for Wireline-Quality Voice. Voice quality is a crucial issue emerging from the American studies of the potential market for PCS. American consumers will demand wireline-quality voice transmission. If wireline-quality voice cannot be achieved, PCS will not be able to break the local exchange monopoly and provide competition in the local residential service. High quality voice transmission demands

encompass high-speed wireless facsimile services and

services. The flexibility of use inherent in PCS spectrum may finally permit those living in rural America to be every bit as advanced a part of our national telecommunications infrastructure as are our urban citizens.

The fact that all rural areas may not require 40 MHz per PCS licensee should not be seen as inefficient but instead should be viewed as a necessary side-effect of the manner in which the Commission has allocated spectrum for more than 60 years. It also could be argued, for example, that it is inefficient to protect the same 400 MHz of spectrum for VHF and UHF television in Truth or Consequences, New Mexico and New York City. It is undoubtedly more efficient to license PCS spectrum to some entity, even in rural areas, than to permit it to lie unassigned and fallow. It would make little sense to create a regional patchwork quilt of allocations, and it would make even less sense to define the services that will be available in cities by spectrum needs that are perceived in less-populated areas.

V. Conclusion

PCS can reach its full potential in the United States only if PCS licensees have access to a sufficient amount of spectrum to avoid interference to incumbent microwave users, provide high-quality voice and high-capacity data transmission services, and respond to the service demands of consumers in both urban and rural America. The studies objectively addressing PCS spectrum requirements unanimously point to the option of assigning PCS licensees 40 MHz each. With this allocation scheme, PCS can be implemented swiftly; it can reach millions of Americans; it can provide high-quality voice and data services; and it can energize the telecommunications marketplace, creating jobs, competition, and tax revenue. It will permit the United States to move ahead in world competition and strengthen our domestic economy. With the critical needs at stake, the Commission can afford to do no less.

PCS *ACTION, INC.*

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**PCS ACTION, INC.'S
KEY RECOMMENDATIONS ON PCS LICENSING**

1. The PCS rulemaking should be finalized within 180 days of enactment of auction legislation, and PCS licenses should be issued within 270 days of auction legislation enactment.
 - The PCS industry is ready now to offer Americans a family of low-cost personal communications services. The only step needed for deployment of this new technology and the generation of new jobs and commercial activity is the issuance of commercial PCS licenses by the FCC.
2. At least 40 MHz of spectrum should be assigned to each PCS license. (See attached discussion points on 40 MHz.)
3. PCS licensing should be implemented in large license areas.
 - PCS licenses need to cover large enough areas to make this business viable, valuable, and competitive. In the cellular industry, for example, nine companies now control service to nearly 90 percent of our population. Small slices of geography would mean the death of a thousand cuts for PCS.
 - Large market areas will make PCS a worthy telecommunications competitor on Day One. They

5. Congress and the FCC must take steps to ensure that PCS is a competitive service providing diversity in wireless communications.
- Because competition is nullified when an entity is matched up against itself, cellular incumbents and their affiliates should be free to apply for PCS licenses anywhere in the country except in their home region.
 - In its home region, a cellular incumbent or its affiliate should be able to apply for a PCS license only if at the date of enactment it serves less than 20 percent of the population to be served by the PCS license.

**AT LEAST 40 MEGAHERTZ OF SPECTRUM
SHOULD BE ASSIGNED TO EACH LICENSEE**

1. Forty MHz per licensee is necessary given the presence of incumbent microwave systems in the band to be allocated to PCS. Comprehensive studies show that any allocation of less than 40 MHz of spectrum per licensee would cripple the deployment of PCS and jeopardize the public interest.
 - A. Unlike the bands allocated to cellular, the band in which PCS is being implemented contains almost 10,000 fixed microwave systems.
 - B. Public Safety Incumbents are permanently grandfathered in the bands to be allocated to PCS.
 - C. Under the FCC's transition plan, incumbent microwave users' involuntarily relocation will not be required for three years from the commencement of PCS licensing.
 - D. A 40-MHz allocation provides room for the operation of PCS without interference by opening up at least twice as much spectrum as would allocations of 20 or 30 MHz. (See generally Comsearch, "Analysis of the 20 MHz, 30 MHz, and 40 MHz PCS Block Allocations," Comments of MCI Telecommunications Corp., FCC Gen. Dkt. 90-314 (Nov. 9, 1992).)
 - E. Forty MHz allotments to each licensee are necessary so PCS can coexist with microwave users during a transition period while some microwave users are reaccommodated to other bands. According to one study focusing on Detroit as a representative metropolitan area

2. Allocations of less than 40 MHz would mean that a PCS licensee would be unable to offer a viable and competitive service. Such allocations would result in substantial geographic areas having no spectrum at all for PCS -- even in markets that are critical for effective PCS roll-out.

- A. A spectrum-availability study of the top 11 cities in the U.S. shows that where five licenses are allocated 20 MHz each, nearly 30 percent of the total area had no spectrum at all available for the implementation of PCS due to the use of spectrum by incumbents. (See generally American Personal Communications (APC), "Report on Spectrum Availability for PCS," FCC Gen. Dkt. 90-314; Nov. 1992.)
- B. According to the APC report, even accounting for the relocation of some microwave users, some cities averaged more than 20 percent of the areas having no spectrum at all available for PCS.
- C. A study of the San Diego MTA (major trading areas, or "MTAs," as defined by Rand McNally) indicates even more severe problems for the San Diego area. (See Reply Comments of Cox Enterprises, Inc., FCC Dkt. 90-134; January 8, 1993.)
- D. A 20-MHz plan would result in extensive disruption, requiring approximately 50 percent of the existing microwave links, including 100 percent of the public safety links, to be relocated within three years of licensing. (Comsearch Case Study, April 12, 1993) Such massive relocations would not, of course, be permissible under the FCC's "transition plan."
- E. Too-small allocations would necessitate a band-clearing strategy and prevent PCS licensees from having sufficient spectrum even to begin PCS implementation in the near term.
 - PCS cannot afford the luxury of rolling out its service gradually as cellular did in the competition-free environment of the mid-1980s. To be competitive, PCS will be forced to build out entire systems for an initial commercial launch.

- Delays would be unavoidable because all PCS licensees would be working simultaneously to relocate thousands of microwave users. Insufficient equipment, engineers, and FCC staff exist to accomplish this massive relocation without substantial delay.
3. Forty MHz is necessary so that PCS can offer a wide range of high-speed data services and information services.
- A. PCS has always been envisioned as providing more than mere voice applications. Data applications envisioned range from facsimile and E-mail to broadband data, advanced intelligent network services, and multimedia. Information services would include graphics, imaging, and compressed video in real time.
- B. These new applications will require significant bandwidth. If these new services must contend for less than 40 MHz of shared spectrum, it is unlikely that PCS will be able to provide them.
4. Allocations of 40 MHz of spectrum are needed to accommodate the demand for PCS, which is estimated to be six times greater than for current cellular services, and to provide wireline-quality voice transmission.
- One study has found that 36-49 MHz of clear spectrum per licensee would be required to service the public's demand for PCS using 32 Kbps voice coding. (See Telocator PCS Technical and Engineering Committee, "Telocator Spectrum Estimates for PCS Report: An Analysis of Clear Spectrum Required to Support Emerging PCS Services" 3 (1992).)

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April 15, 1993

BY MESSENGER

Ms. Cora Beebe
Office of Management and Budget
New Executive Office Building
725 17th Street, N.W., Room 9202
Washington, D.C.

Re: Personal Communications Services

Dear Cora:

As we discussed last week, we have estimated that the inauguration of personal communications services ("PCS") would create 300,000 good new jobs. This estimate is consistent with an estimate by Telocator¹ that 250,000 service jobs and 50,000 manufacturing jobs would be created by the implementation of PCS. Telocator also has estimated that 60,000,000 Americans will subscribe to PCS by the year 2002.

Our specific analysis shows that PCS will create some 280,867 jobs by the year 2008 (or by 2002 under Telocator's projections). These jobs would be created in three broad categories: direct employment by PCS companies, indirect employment, and manufacturing employment.

Direct Employment (102,134 jobs). The analysis begins with employee-subscriber ratios drawn from other start-up telecommunications industries. At mid-point in the PCS industry's development, the analysis utilizes employee-subscriber ratios consistent with current cellular industry

^{1/} Telocator is a long-standing trade association representing companies in the cellular, paging and personal communications industries.

Ms. Cora Beebe
April 15, 1993
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employment.^{2/} Rather than continue with that ratio, the analysis utilizes more conservative ratios as the PCS industry grows to reflect greater efficiencies being realized.^{3/}

Indirect Employment (127,667 jobs). This category includes dealers, distributors, resellers, consultants, engineering, billing and maintenance contractors, and other types of jobs that are created indirectly by the activities of PCS licensees. It is based on ratios that have been experienced in the cellular industry, which provides a useful analogue for PCS. The use of cellular figures is conservative in that PCS may be significantly more infrastructure-intensive than cellular and thus produce more indirect employment in engineering and construction services in its growth years.

Manufacturing Employment (40,853 jobs). The analysis assumes an export-import ratio of only 1:1.25 (that is, we export 25 percent more than we import). This is also quite conservative; as you know, our balance of trade in wireless telecommunications equipment traditionally is quite good and will improve if we can implement PCS swiftly and thus gain a foothold in the immense international market for PCS.^{4/}

2/ This analysis is very conservative in that it begins with employment ratios associated with the cellular industry rather than significantly lower ratios associated with the landline telephone industry (which if applied to PCS would probably double our job estimate). Some would argue that the latter figures may be more appropriate for PCS in the long

Ms. Cora Beebe
April 15, 1993
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The number of jobs created per dollar of manufacturing output is consistent with the current employment practices of large telecommunications manufacturers with whom we consulted in crafting this analysis.

Please give me a call with any questions about this analysis. We have not forgotten your invitation for comments on specific auction processes that could be utilized and will

PCS ACTION, INC.

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RECOMMENDATIONS ON PCS REGULATORY ISSUES

July 21, 1993

PCS ACTION, INC.

- PCS Action, Inc. is a coalition of companies committed to rapid roll-out of PCS services.
- PCS Action's Service Provider Members include:
American Personal Communications/The Washington Post Co.
Associated PCN Company
Cox Enterprises, Inc.
Crown Media
MCI Telecommunications Corporation
Omnipoint Corporation
Providence Journal Company
Times Mirror Cable Television, Inc.
Time Warner Telecommunications
- PCS Action's Manufacturing Members include:
Motorola Inc.
Northern Telecom
QUALCOMM, Inc.
- PCS Action members have invested more than \$100 million in PCS research and development.

PERSONAL COMMUNICATIONS SERVICES

- PCS is expected to become a \$200 billion business and create 200,000 new jobs by the end of the decade.